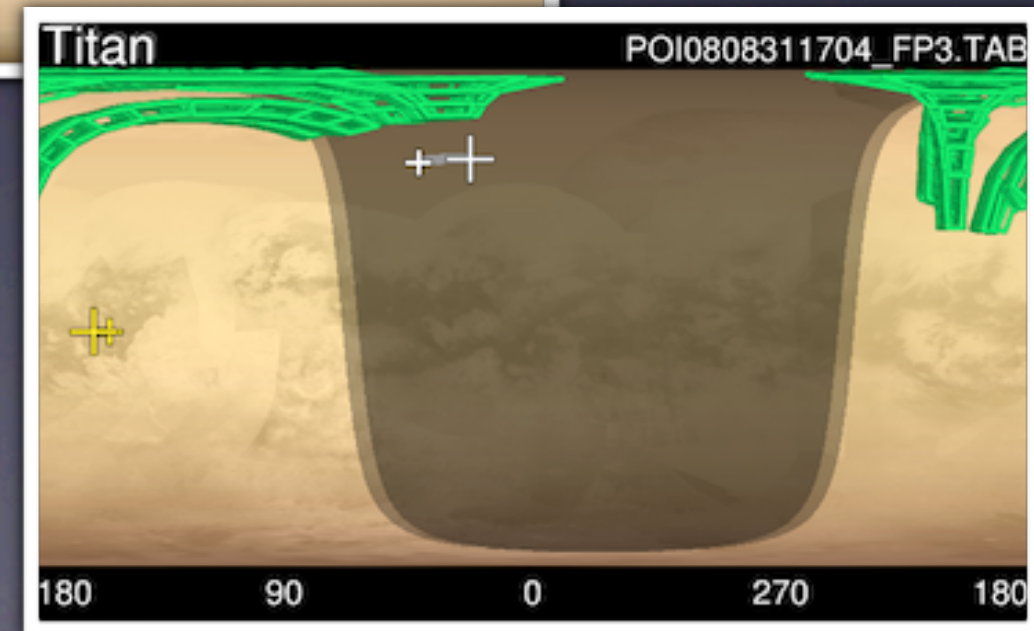
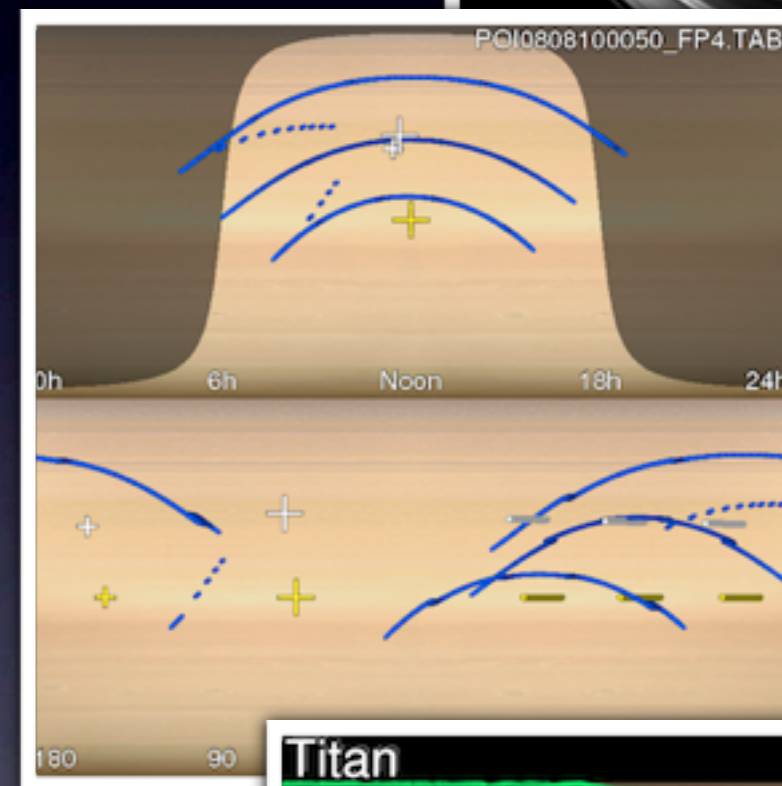
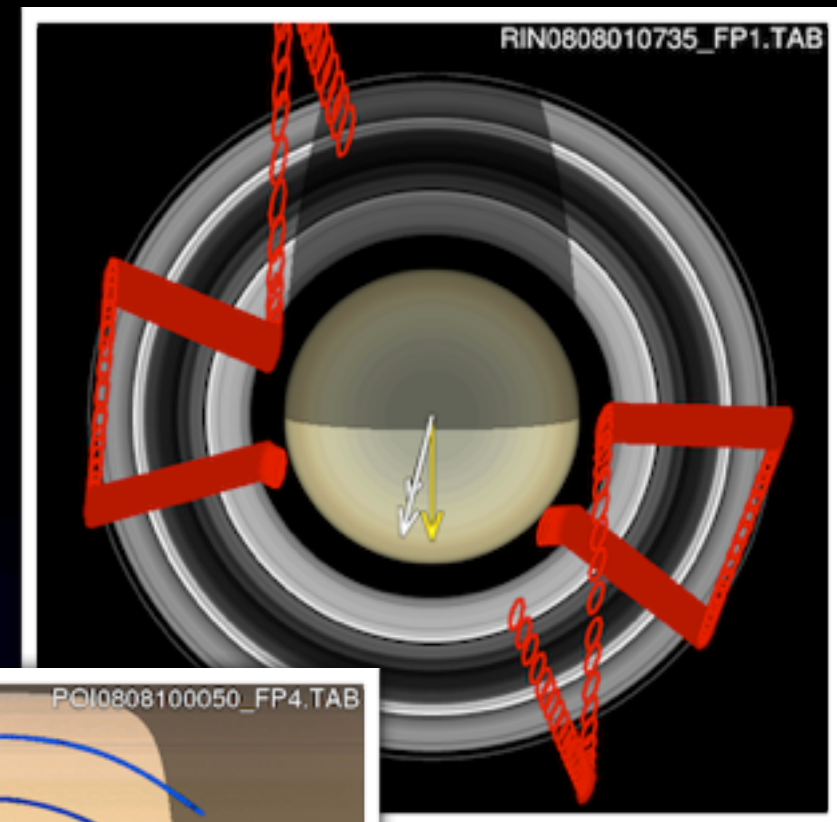


# Rings Node Report

Mark Showalter & Mitch Gordon  
PDS Management Council Meeting  
Washington, DC  
March 25, 2010

# Cassini CIRS Re-formatting

- Pipeline rebuilt to satisfy liens.
- New diagrams generated.
- Entire data set regenerated from COCIRS 2.0.
- The review panel missed a few things...
  - E.g., each spectrum now includes an indication of whether the shutter was open or not!





# Cassini CIRS Re-formatting

## Lessons Learned

- Get the team to do it right the first time.

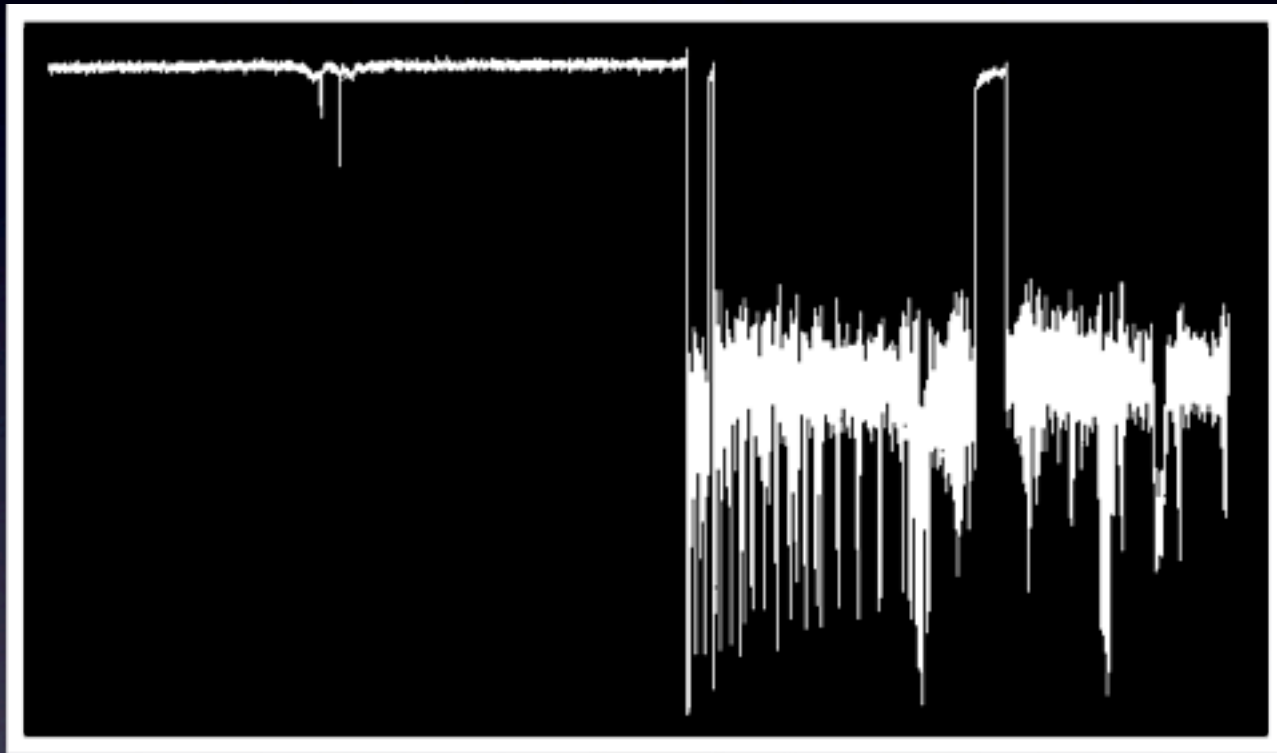
# Cassini CIRS Re-formatting

## Lessons Learned

- Get the team to do it right the first time.
- This is way easier said than done.

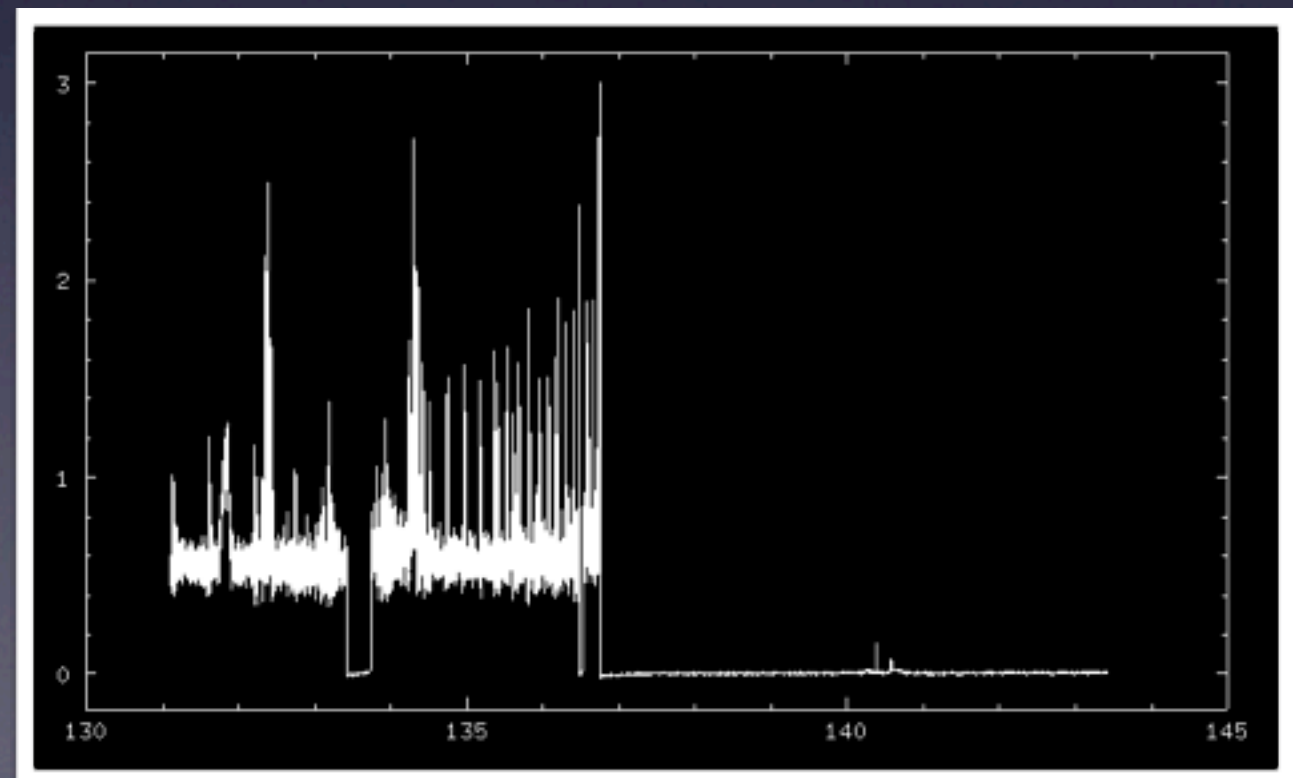
# Cassini UVIS Occultations

Supported by CDAP funding to Josh Colwell



Uncalibrated:  
Photon counts vs. time,  
binary formats

Calibrated:  
Optical depth vs. radius,  
ASCII formats





# HST (Re-Re-) Archiving

- Our Original Goals:
  - Fully integrate HST data into OPUS.
  - Mainly images of outer planets.
  - Let users download HST data directly from an OPUS search.
  - Produce usable, PDS-compliant, complete metadata and indices.

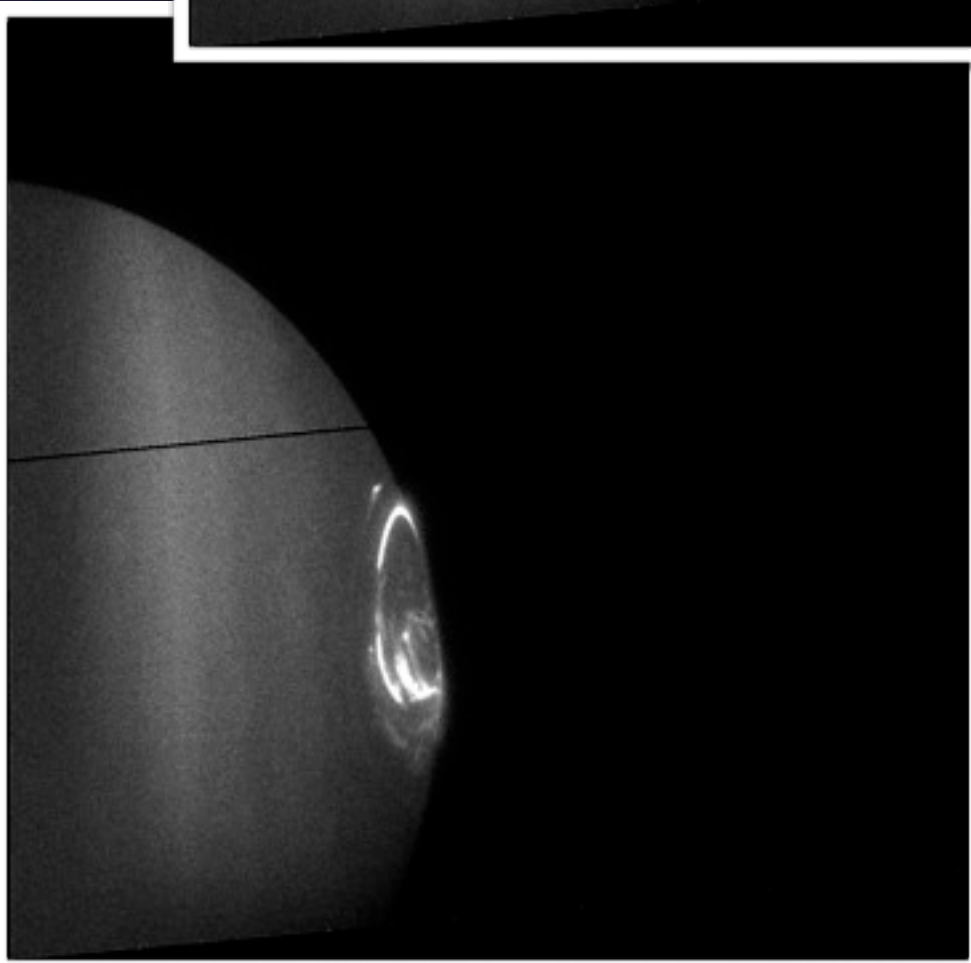
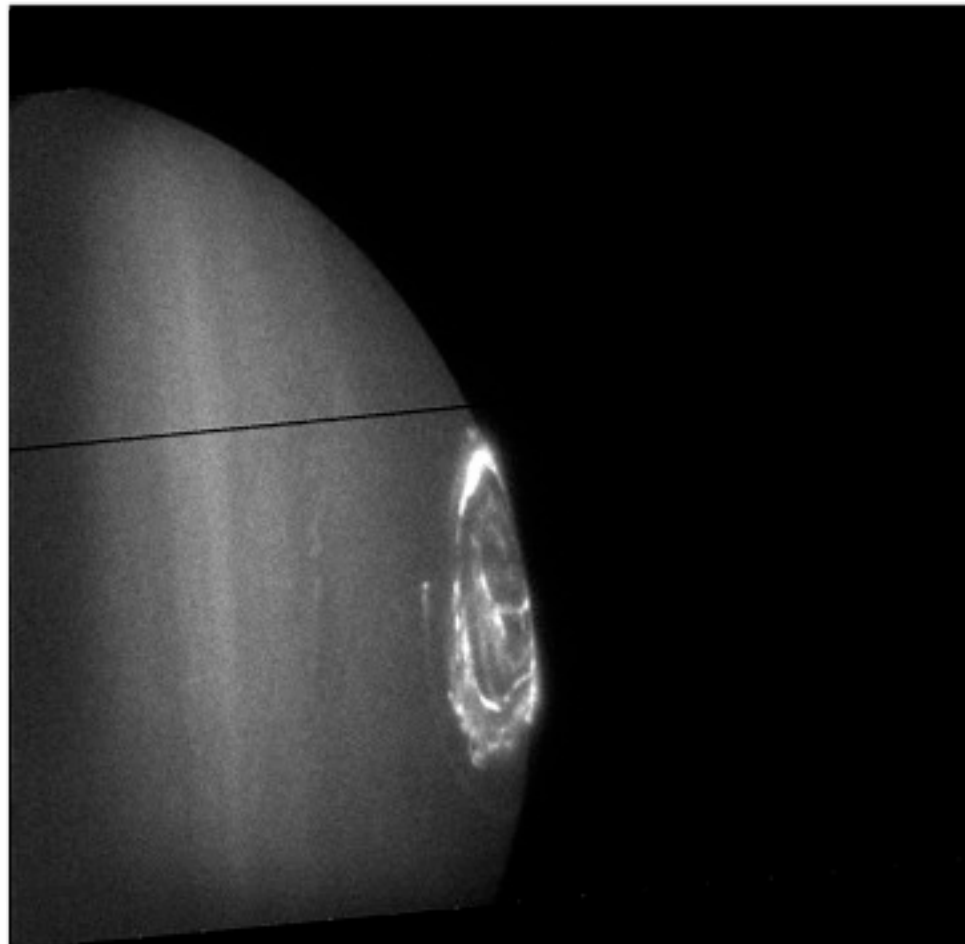
# HST (Re-Re-) Archiving

- The Problem:
  - STScI revised every data product before we finished.
  - STScI updates their calibration pipeline and file formats whenever they like, without warning.

# HST (Re-Re-) Archiving

- Our ~~Original~~ *Revised* Goals:
  - ~~Fully~~ *Partially* integrate HST data into OPUS.
  - Let users ~~download~~ *preview* HST data directly from an OPUS search.  
*... and provide instructions on how to request the data from STScI.*
  - Produce usable, PDS-compliant *nearly* complete metadata and indices.





```

/*****
/*****
fitsfile= 'J9DU03B3Q_DRZ.FITS' / name of file from the STScI archive
headerno=          1 / header number in file, starting at 1
recordno=          1 / record number in file, starting at 1
/*****

SIMPLE  =          T / conforms to FITS standard
BITPIX  =          8 / array data type
NAXIS   =          0 / number of array dimensions
EXTEND   =          T
ORIGIN   = 'NOAO-IRAF FITS Image Kernel July 2003' / FITS file originator
IRAF-TLM= '21:12:50 (25/09/2009)' / Time of last modification
NEXTEND  =          3 / Number of standard extensions
DATE     = '2009-09-25T21:12:50' / date this file was written (yyyy-mm-dd)
FILENAME= 'j9du03b3q_drz.fits' / name of file
FILETYPE= 'SCI'      / type of data found in data file

TELESCOP= 'HST'      / telescope used to acquire data
INSTRUME= 'ACS'      / identifier for instrument used to acquire data
EQUINOX  =          2000.0 / equinox of celestial coord. system

          / DATA DESCRIPTION KEYWORDS

ROOTNAME= 'j9du03b3q' / rootname of the observation set
IMAGETYP= 'EXT'      / type of exposure identifier
PRIMESI  = 'ACS'      / instrument designated as prime

          / TARGET INFORMATION

TARGNAME= 'JUPITER3' / proposer's target name
RA_TARG  =  2.259050923144E+02 / right ascension of the target (deg) (J2000)
DEC_TARG = -1.592159661850E+01 / declination of the target (deg) (J2000)

          / PROPOSAL INFORMATION

PROPOSID=          10507 / PEP proposal identifier
LINENUM  = '03.001'    / proposal logsheet line number
PR_INV_L= 'Grodent'    / last name of principal investigator
PR_INV_F= 'Denis'      / first name of principal investigator
PR_INV_M= ' '          / middle name / initial of principal investigat

          / EXPOSURE INFORMATION

SUNANGLE=          138.593323 / angle between sun and V1 axis
MOONANGL=          109.851707 / angle between moon and V1 axis
SUN_ALT  =          -16.545755 / altitude of the sun above Earth's limb
FGSLOCK  = 'FINE'      / commanded FGS lock (FINE,COARSE,GYROS,UNKNOWN)
GYROMODE= '2'          / number of gyros scheduled for observation
REFFRAME= 'GSC1'      / guide star catalog version

DATE-OBS= '2006-03-27' / UT date of start of observation (yyyy-mm-dd)
TIME-OBS= '09:01:53'  / UT time of start of observation (hh:mm:ss)
EXPSTART=          53821.37630852 / exposure start time (Modified Julian Date)
EXPEND   =          53821.37753111 / exposure end time (Modified Julian Date)
EXPTIME  =          105.0 / exposure duration (seconds)--calculated
EXPFLAG  = 'NORMAL'    / Exposure interruption indicator

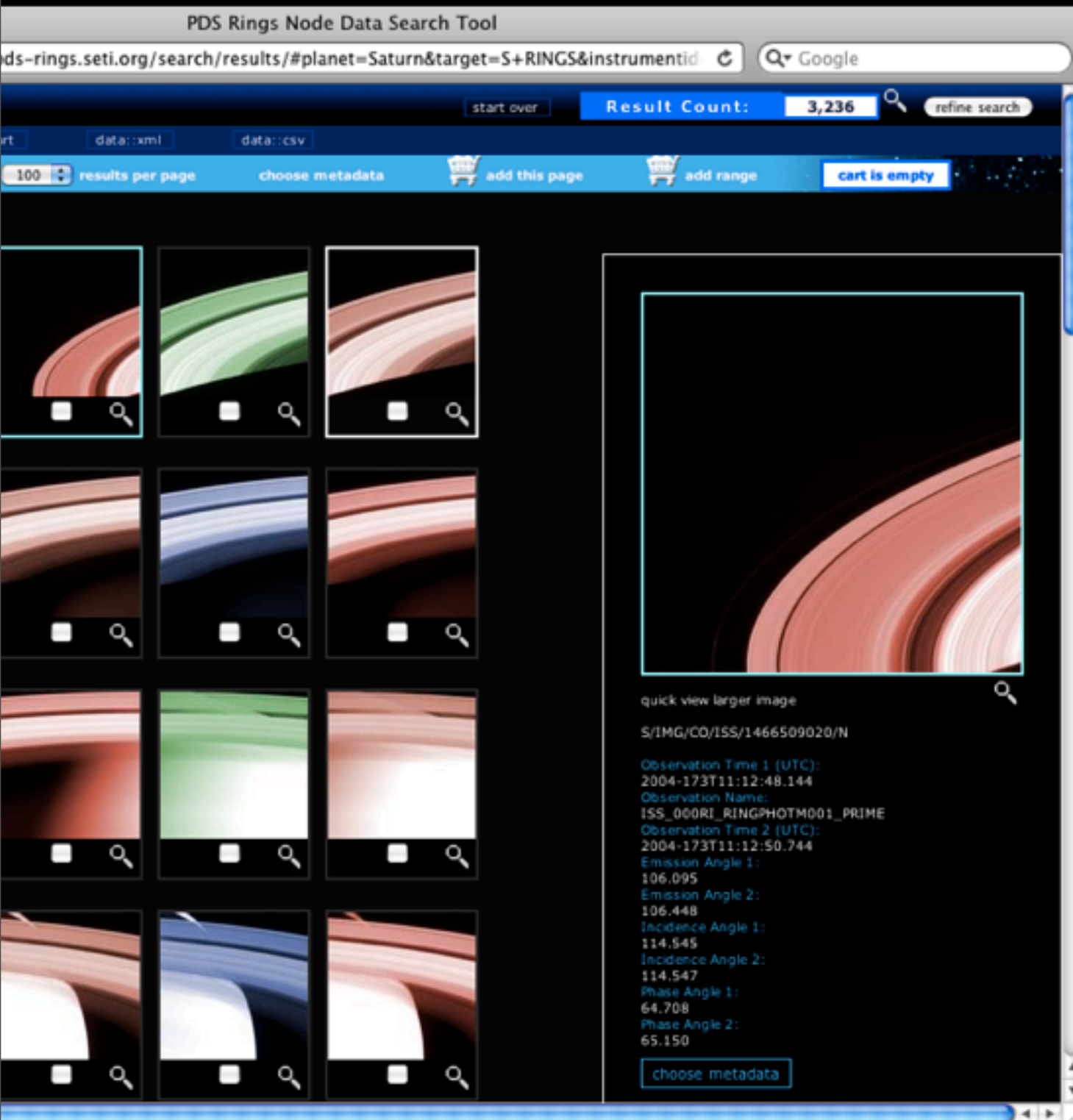
```

# HST (Re-Re-) Archiving

- Our Solution:
  - Every HST observation is now a DOCUMENT object.
  - The document includes TIFFs and JPEGs of the images (but not the FITS files).
  - The document contains all the FITS header parameters from the files.

# OPUS Development

## “Outer Planets Unified Search”



- We remain current with Cassini deliveries
- Most recent changes are “under the hood”
  - Performance issues
  - REST-ful interface



OPUS – NASA PDS Rings Node's Outer Planet Unified Search tool

http://pds-rings.seti.org/search/#planet=Satu Google

OPUS recent changes contact us start over Result Count: 84 View Results

☒ General Constraints

Ring Geometry Constraints

Wavelength Constraints

Cassini Mission Constraints

Cassini VIMS Constraints

### General Constraints

☒ Planet *i*  
☐ Jupiter ☒ Saturn ☐ Uranus ☐ Neptune ☐ Venus ☐ Earth

☒ Nominal Target Name *i*  
Saturn Targets  
☐ ATLAS ☐ CALYPSO ☐ DAPHNIS ☐ DIONE ☐ ENCELADUS  
☒ EPIMETHEUS ☐ HELENE ☐ HYPERION ☐ IAPETUS ☐ JANUS  
☐ METHONE ☐ MIMAS ☐ PALLENE ☐ PAN ☐ PANDORA ☐ PHOEBE  
☐ POLYDEUCES ☐ PROMETHEUS ☐ RHEA ☐ S RINGS ☐ SATURN  
☐ TELESTO ☐ TETHYS ☐ TITAN ☐ UNKNOWN  
Jupiter Targets  
Neptune Targets  
Uranus Targets  
Other Targets

☐ Nominal Target Class *i*

☐ Mission *i*

☐ Instrument Host Name *i*

☒ Instrument Name *i*  
☐ Cassini ISS ☐ Cassini CIRS ☒ Cassini VIMS ☐ Cassini UVIS  
☐ Galileo SSI ☐ Hubble ACS ☐ Voyager ISS ☐ New Horizons LORRI  
☐ Hubble WFPC2 ☐ Voyager IRIS ☐ Hubble NICMOS

☐ Observation Time *i*

☐ Target Intercept Time

☐ Observation Duration

☐ Observation Class *i*

☐ Measurement Quantity *i*

☐ Data Type *i*

☐ Note *i*

☐ Right Ascension *i*

# OPUS

On every user click...

OPUS – NASA PDS Rings Node's Outer Planet Unified Search tool

http://pds-rings.seti.org/search/#planet=Saturn

OPUS recent changes contact us start over **Result Count: 84** View Results

### General Constraints

- ☒ Planet
  - ☐ Jupiter ☒ **Saturn** ☐ Uranus ☐ Neptune ☐ Venus ☐ Earth
- ☒ Nominal Target Name
  - Saturn Targets**
    - ☐ ATLAS ☐ CALYPSO ☐ DAPHNIS ☐ DIONE ☐ ENCELADUS
    - ☒ **EPIMETHEUS** ☐ HELENE ☐ HYPERION ☐ IAPETUS ☐ JANUS
    - ☐ METHONE ☐ MIMAS ☐ PALLENE ☐ PAN ☐ PANDORA ☐ PHOEBE
    - ☐ POLYDEUCES ☐ PROMETHEUS ☐ RHEA ☐ S RINGS ☐ SATURN
    - ☐ TELESTO ☐ TETHYS ☐ TITAN ☐ UNKNOWN
  - [Jupiter Targets](#)
  - [Neptune Targets](#)
  - [Uranus Targets](#)
  - [Other Targets](#)
- Nominal Target Class
- Mission
- Instrument Host Name
- ☒ Instrument Name
  - ☐ Cassini ISS ☐ Cassini CIRS ☒ **Cassini VIMS** ☐ Cassini UVIS
  - ☐ Galileo SSI ☐ Hubble ACS ☐ Voyager ISS ☐ New Horizons LORRI
  - ☐ Hubble WFPC2 ☐ Voyager IRIS ☐ Hubble NICMOS
- Observation Time
- Target Intercept Time
- Observation Duration
- Observation Class
- Measurement Quantity
- Data Type
- Note
- Right Ascension

Thursday, March 25, 2010

# OPUS

On every user click...

- The result count updates.

OPUS – NASA PDS Rings Node's Outer Planet Unified Search tool

http://pds-rings.seti.org/search/#planet=Satu Google

OPUS recent changes contact us start over Result Count: 84 View Results

☒ General Constraints

Ring Geometry Constraints

Wavelength Constraints

☒ Cassini Mission Constraints

Cassini VIMS Constraints

General Constraints

☒ Planet *i*

☐ Jupiter ☒ Saturn ☐ Uranus ☐ Neptune ☐ Venus ☐ Earth

☒ Nominal Target Name *i*

Saturn Targets

☐ ATLAS ☐ CALYPSO ☐ DAPHNIS ☐ DIONE ☐ ENCELADUS

☒ EPIMETHEUS ☐ HELENE ☐ HYPERION ☐ IAPETUS ☐ JANUS

☐ METHONE ☐ MIMAS ☐ PALLENE ☐ PAN ☐ PANDORA ☐ PHOEBE

☐ POLYDEUCES ☐ PROMETHEUS ☐ RHEA ☐ S RINGS ☐ SATURN

☐ TELESTO ☐ TETHYS ☐ TITAN ☐ UNKNOWN

Jupiter Targets

Neptune Targets

Uranus Targets

Other Targets

Nominal Target Class *i*

Mission *i*

Instrument Host Name *i*

☒ Instrument Name *i*

☐ Cassini ISS ☐ Cassini CIRS ☒ Cassini VIMS ☐ Cassini UVIS

☐ Galileo SSI ☐ Hubble ACS ☐ Voyager ISS ☐ New Horizons LORRI

☐ Hubble WFPC2 ☐ Voyager IRIS ☐ Hubble NICMOS

Observation Time *i*

Target Intercept Time

Observation Duration

Observation Class *i*

Measurement Quantity *i*

Data Type *i*

Note *i*

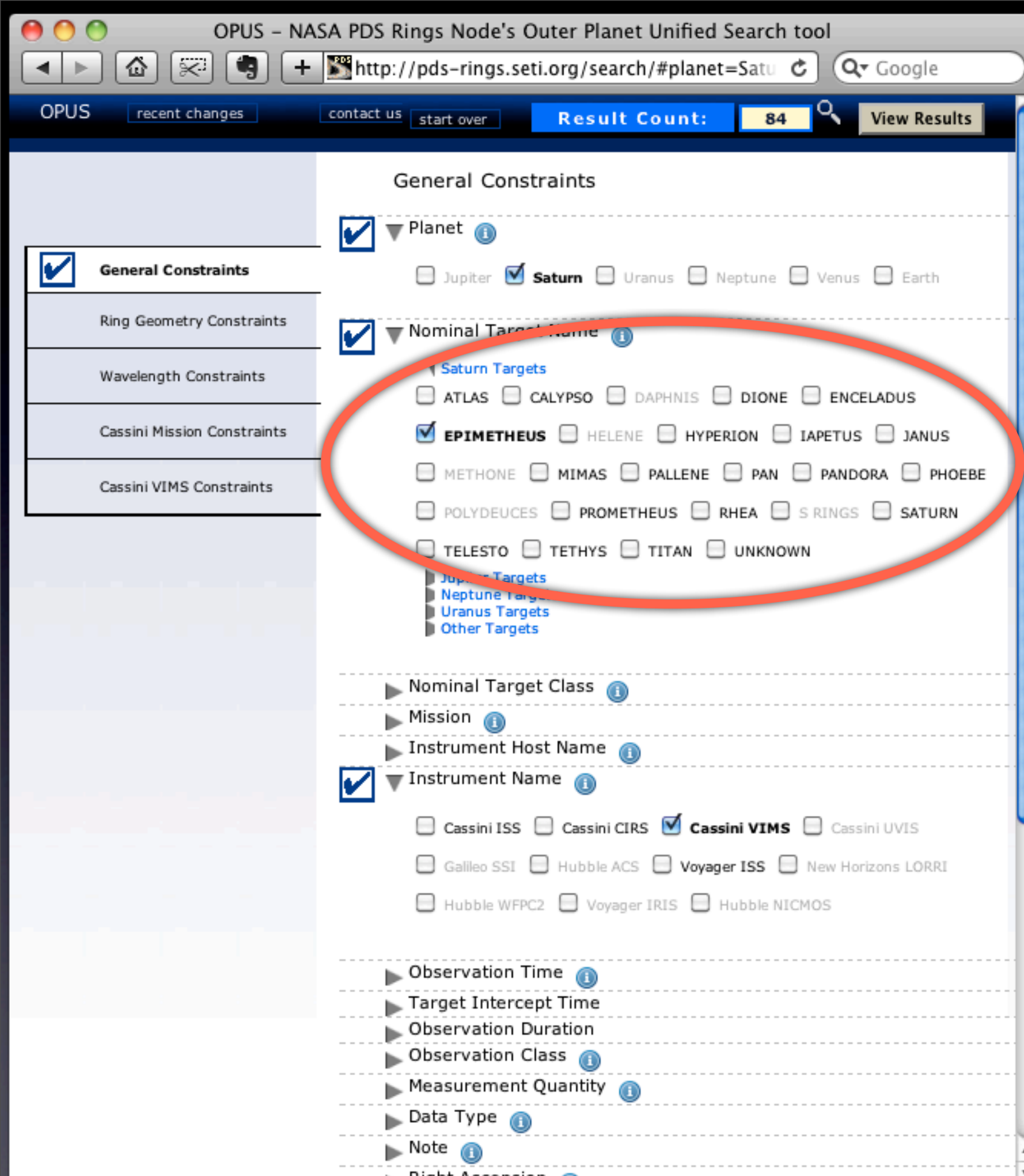
Right Ascension *i*

# OPUS

On every user click...

- The result count updates.
- The tab selection updates.

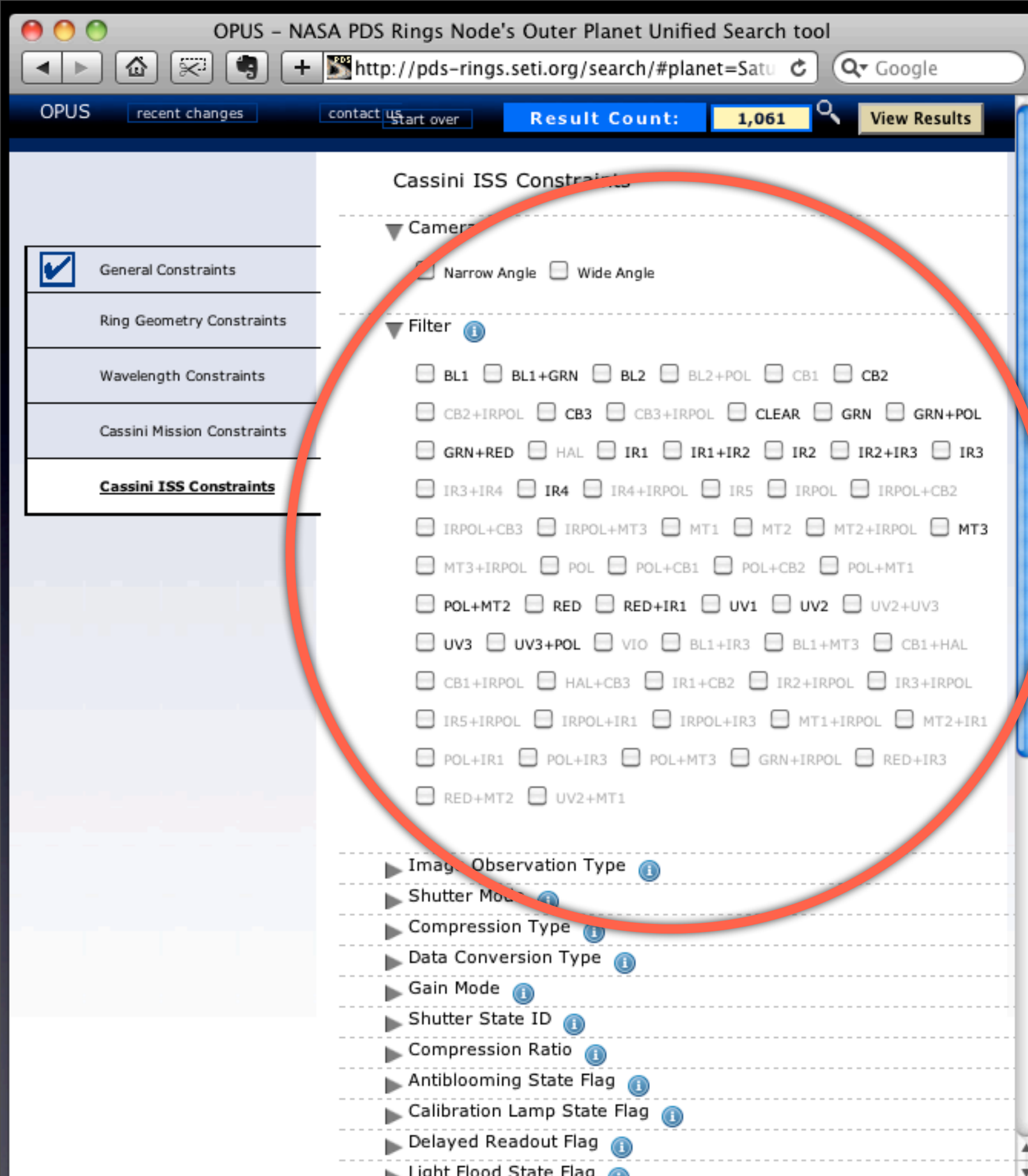




# OPUS

On every user click...

- The result count updates.
- The tab selection updates.
- Remaining options that would return no hits turn gray.



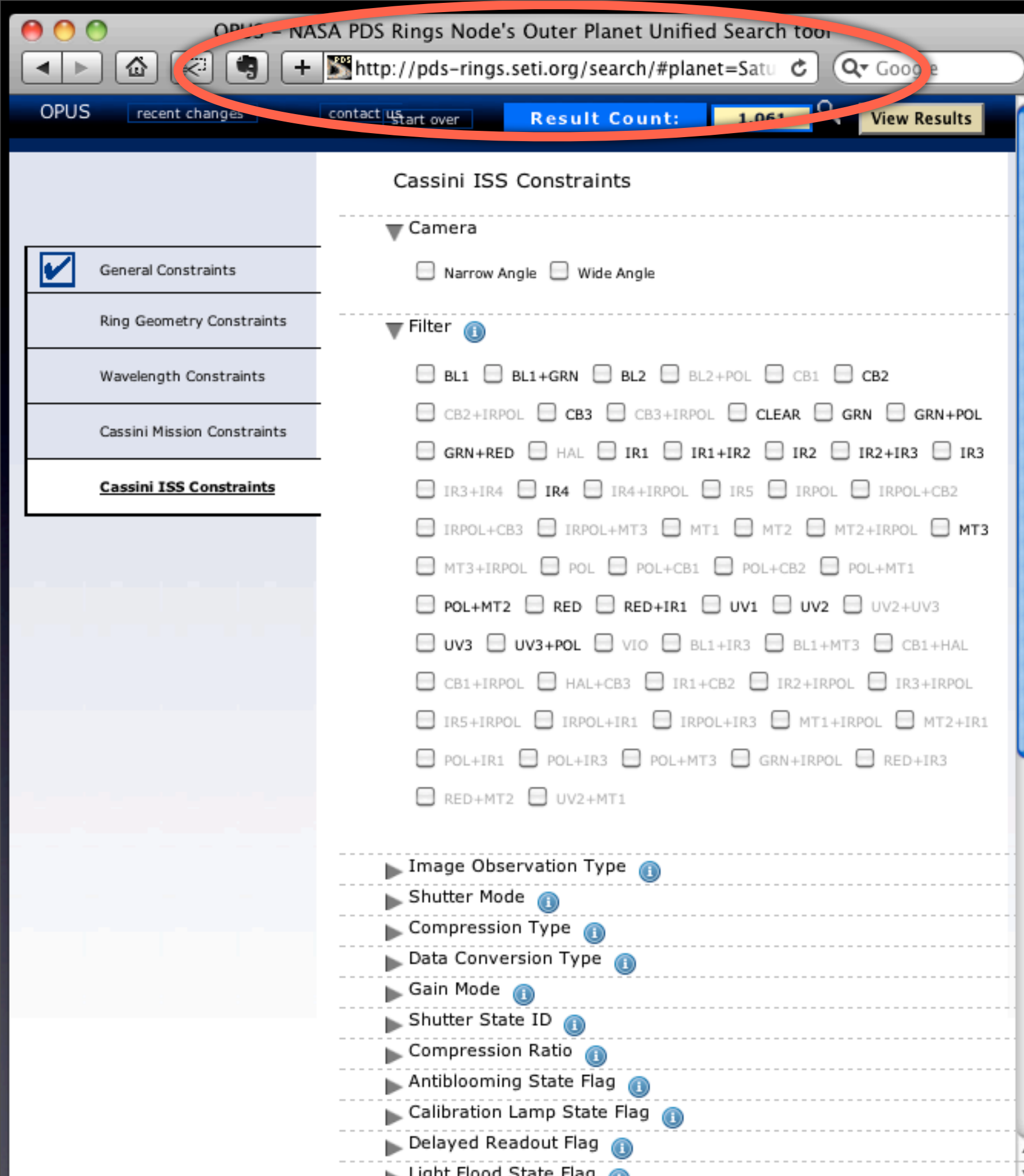
# “Asynchronous Communication”

The advantage:

- The user gets immediate feedback about available data when exploring.
- Users like it.

The disadvantage:

- Our server has to handle potentially dozens of queries on the database all at once.



# REST-ful URLs

<http://pds-rings.seti.org/search/>

`#planet =  
Saturn`

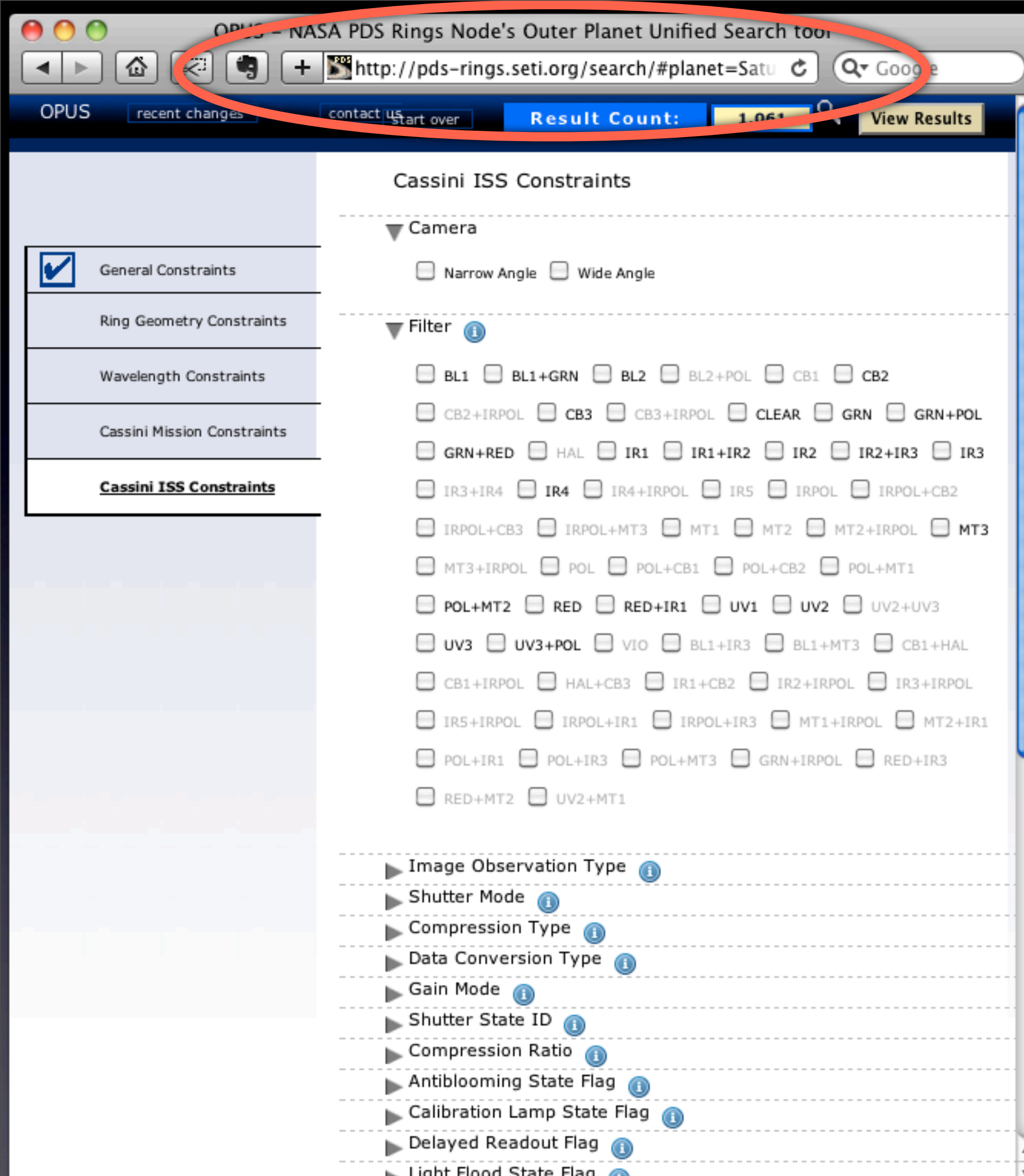
`&target =  
EPIMETHEUS`

`&instrumentid =  
Cassini+ISS`

`&tab =  
obs_instrument  
_COISS`

`&open =  
planet, target,  
instrumentid,  
FILTER, camera`





# REST-ful URLs

The advantage:

- This begins the decoupling of the user interface from the search service.
- You can bookmark any step in a search.
- ANYBODY can create a web-based tool that accesses our service.

# Geometric Metadata

OPUS - NASA PDS Rings Node's Outer Planet Unified Search tool

http://pds-rings.seti.org/search/#planet=Saturn&target=S+RINGS&instrumentid Google

OPUS recent changes contact us start over Result Count: 691 View Results

### Ring Geometry Constraints

- ☒ General Constraints
- ☒ **Ring Geometry Constraints**
- Wavelength Constraints
- Cassini Mission Constraints
- ☒ Cassini ISS Constraints

☒ Ring Radius ⓘ  
min: 140000 max: 145000 [x] [...] km any [v] what's this? add range

▶ J2000 Ring Longitude ⓘ  
▶ Sub Observer Ring Longitude ⓘ  
▼ Solar Hour Angle ⓘ  
min: max: [x] [...] any [v] what's this? add range

▶ Ring Intercept Time ⓘ  
▶ Ring Plane Resolution ⓘ  
▶ Range to Ring Intercept ⓘ  
▶ Sub Observer Latitude ⓘ  
▶ Phase Angle ⓘ  
▼ Incidence Angle ⓘ  
min: max: [x] [...] any [v] what's this? add range

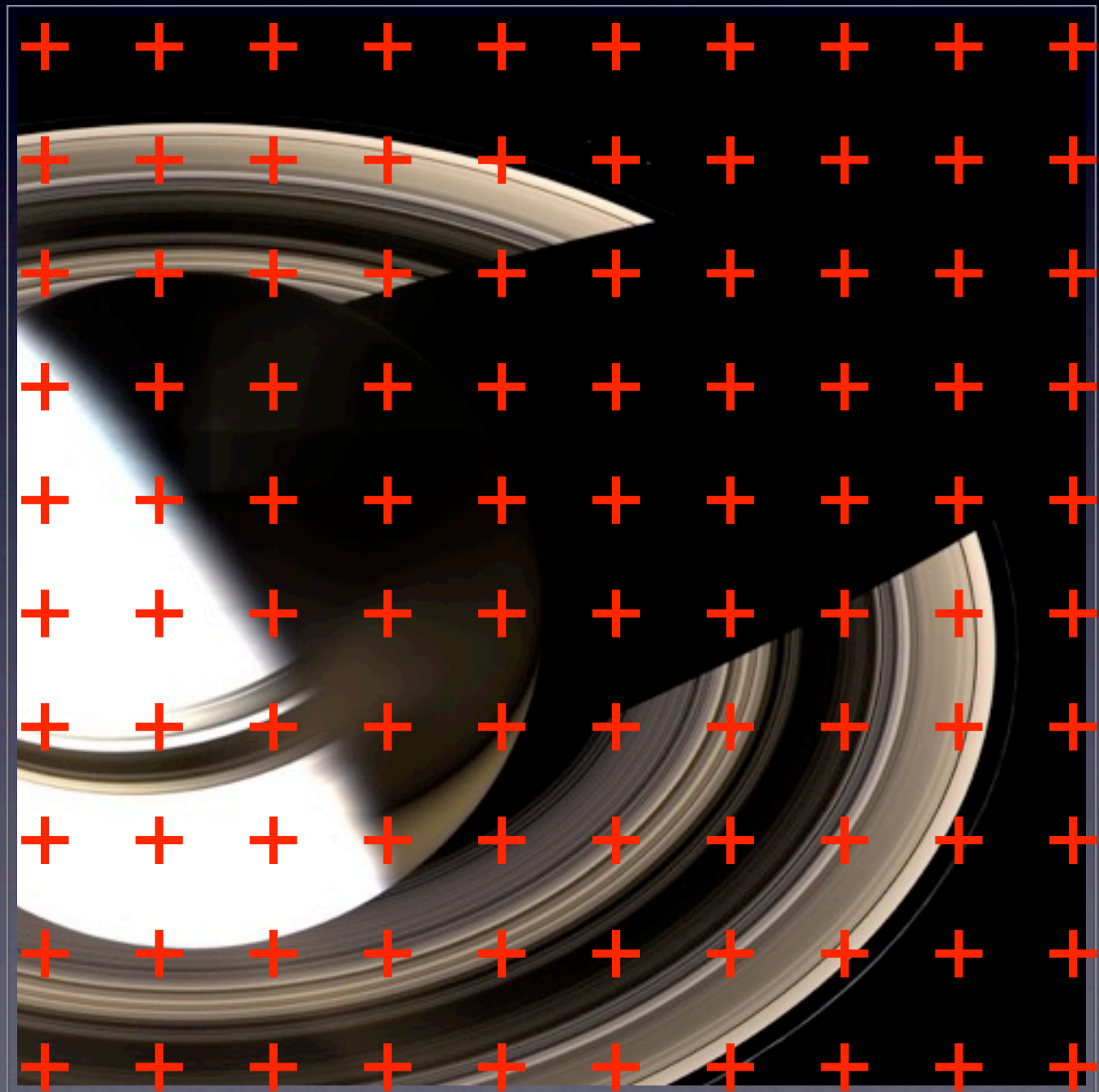
▶ Emission Angle ⓘ  
▶ Planet Behind Ring Flag ⓘ  
▶ Ring Shadow Flag ⓘ  
▶ Edge-On Ring Resolution ⓘ  
▶ Edge-On Point Range ⓘ  
▶ Edge-On Ring Radius ⓘ  
▶ Edge-On Solar Hour Angle ⓘ  
▶ Edge-On J2000 Longitude ⓘ  
▶ Edge-On Ring Elevation ⓘ

show alert

...Accomplished with a little financial help from Jeff Cuzzi & the Cassini Project



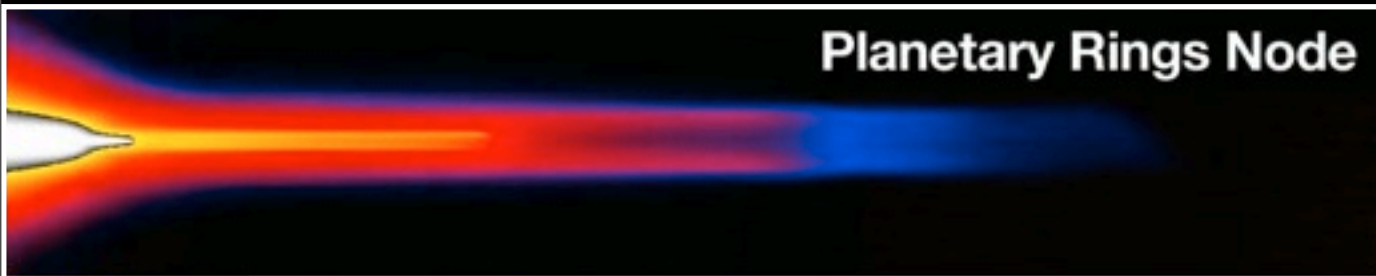
...based on a fine  
sampling of the  
entire field of view





# Web Site Re-design...

Mock-ups and discussions  
are in progress



## Planetary Rings Node

The *Rings Node* of [NASA's Planetary Data System](#) is devoted to archiving, cataloging, and distributing scientific data sets relevant to planetary ring systems.

**Rings Node Home**  
**Cassini News**  
Cassini Mission (JPL)  
Press Release Images  
Data and Information  
**Ringed Planets**  
Jupiter  
Saturn  
Uranus  
Neptune  
**Missions and Data**  
**Data Search ...**  
New Horizons  
Cassini  
Voyager  
Galileo  
Hubble Telescope  
Saturn RPX 1995  
Uranus RPX 2007  
Occultations  
Astrometry  
**Downloads**  
Data volumes  
Compressed archives  
Previews/Thumbnails  
**Resources**  
Tools  
Toolkits  
Glossary  
**Contacts**  
Mark Showalter  
Mitch Gordon  
Neil Heather  
Lisa Ballard  
Submit a comment

**Recent Highlights**

- Improved Data Search (OPUS).**  
Try our [Outer Planets Unified Search \(OPUS\)](#).
  - Thumbnails of your results are tinted to indicate filter used.
  - You can bookmark your search results and return to them at a later time.
- Cassini ISS Calibration Software Update.**  
CISSCAL updated to version 3.6 along with updated calibration files and documents.
  - Browse the revised [COISS\\_0011](#) volume.
  - Download the [tar.gz bundle](#).
  - See [ISS Software](#) for a summary of the changes.
- Saturn Ring Plane Crossing 2009.**  
Information on the events with links to observations available from our [Saturn RPX](#) web page.
- Research Proposal Support.**  
Our [support pages](#) provide information and links to data for rings related AOs in 2009.
- Resonances in Saturn's Rings.**  
Download tables of locations and strengths for [resonances in the main rings](#).
- E/PO Uranus Equinox 2007.**  
Watch [Uranus: A World of Surprises](#), our 2007 museum presentation developed in collaboration with [Space Telescope Science Institute](#).
- Other on line [recent changes](#) at the Rings Node.

PDS Atmospheres Geosciences Imaging NAIF PPI Rings Small Bodies

SETI Institute  
+ Carl Sagan Center for the Study of Life in the Universe

Node Manager: Mark R. Showalter  
Webmaster: Neil Heather



## Planetary Data System The Rings Node

Google Custom Search Search  
The Rings Node The Web

Home || News & Education || Missions & Data || Research Support || Search for Data || Submit a Comment || Site Map

**Outer Planets Unified Search Logo & Link**

**Welcome to the Rings Node**  
The Rings Node of [NASA's Planetary Data System](#) archives, catalogs and distributes scientific data sets relevant to planetary dynamics and ring-moon systems.

**Quick Links**

- Rings in the News:**
  - Latest from Cassini
  - Cassini Home (JPL)
- Photo Favorites:**
  - Jupiter
  - Saturn
  - Uranus
  - Neptune
- For Scientists:**
  - Cassini
  - New Horizons
  - Galileo
  - Voyager
  - Hubble Telescope
  - Earth-Based Data
  - Occultations
  - Astrometry
- About Us:**
  - Planetary Data System
  - SETI Institute

**Saturn at Equinox, August 11, 2009**  
Cassini's cameras captured this stunning view of Saturn just as the Sun was crossing the ring plane. [Read more...](#)

**What's New...**

- Improved Data Search**
  - Try our new option to search for movie sequences.
  - Bookmark search results and return to them later.
- Cassini ISS Calibration Software**
  - CISSCAL 3.6 has been released.
  - Browse the revised volume [COISS\\_0011](#).
  - Download the [tar.gz bundle](#)
  - Learn more.
- Saturn Equinox 2009**
  - Information about the latest events is on line.
  - See the [latest results](#) from Cassini.
- Resonances in Saturn's Rings**
  - Download a [new table](#) of locations and strengths.
- More updates...**

PDS Atmospheres Geosciences Imaging Navigation Plasma/Particle Interactions Rings Small Bodies

SETI Institute  
+ The Carl Sagan Center for the Study of Life in the Universe

Node Manager: Mark R. Showalter  
Webmaster: Neil Heather  
NASA Official: William P. Knopf

Keywords for Rings Node internal indexing: planetary rings, planetary rings data, planetary rings images, planetary rings spectra, jupiter rings, jupiter rings data, jupiter rings images, jupiter rings spectra, saturn rings, saturn rings data, saturn rings images, saturn rings spectra, uranian rings, uranian rings data, uranian rings images.



# OPUS: Outer Planets Unified Search

## Quick Start Page

[OPUS Help](#)  
[Update & change history](#)  
[Submit a comment/report a bug](#)

Click any relevant boxes, watch the observation count at right, then click "Go!" to see results.

### Target Requirements:

#### [Planet:](#)

- ☒ Jupiter
- ☐ Saturn
- ☐ Uranus
- ☐ Neptune

#### [Target type:](#)

- ☐ Planet
- ☐ Ring
- ☒ Moon
- ☐ Star
- ☐ Sky
- ☐ Other

...or enter a [target name](#):

...or select target from [list](#)

### Data Source:

#### From [mission](#):

- ☐ Cassini
- ☐ Earth-based Telescope
- ☒ Galileo
- ☐ Hubble Telescope
- ☐ New Horizons
- ☐ Voyager

#### [Instrument type:](#)

- ☒ Camera
- ☐ Near-IR Spectrometer
- ☐ Thermal IR Spectrometer
- ☐ UV Spectrometer
- ☐ High-Speed Photometer

...or select mission & instrument name from [list...](#)

### Measurement Needs:

#### [Measurement quantity:](#)

- ☐ Intensity or reflectivity
- ☐ Opacity

#### [Spatial sampling type:](#)

- ☐ Profiles (1-D)
- ☐ Images (2-D)
- ☐ Extended 2-D ("mosaics")

#### [Wavelength band:](#)

- ☐ Visual
- ☐ Near IR
- ☐ Thermal IR
- ☐ Radio
- ☐ UV

#### [Wavelength sampling type:](#)

- ☐ Detailed ("spectra")
- ☐ Limited ("color")

#### [Timespan:](#)

- ☐ Minutes ("movies")
- ☐ Days
- ☐ Years

#### [Time sampling:](#)

- ☐ Minutes
- ☐ Hours
- ☐ Days

### I would also like to limit my search further based on...

- ☐ Subregion on the target and/or spatial resolution
- ☐ Lighting and viewing geometry on the target
- ☐ Wavelength and bandpass
- ☐ Time limits and duration
- ☐ Mission- and instrument-specific parameters

[Refine query further...](#)

## Result Summary

Observation count: 3202

[Show me my results](#)

Break down results by...

#### Target name ▼

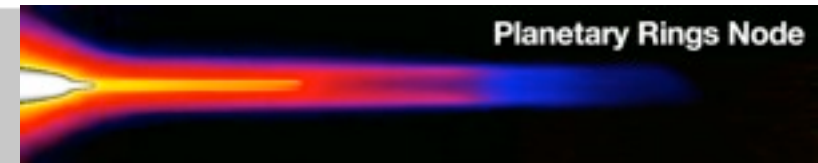
Adrastea	5
Amalthea	4
Io	104
Europa	1202
Ganymede	877
Callisto	1010

#### Instrument ▼

Galileo SSI	3202
-------------	------

#### Select... ▼





# OPUS: Outer Planets Unified Search

[OPUS Help](#)  
[Update & change history](#)  
[Submit a comment/report a bug](#)

Query

Results & Collections

Closer Look

## General...

☒ Basics

☐ Ring Geometry

☒ Surface Geometry

## Sampling...

☐ Spatial 2-D (images)

☒ Spatial 1-D (profiles)

☒ Time (movies)

☐ Wavelength (spectra)

## Mission...

☐ Cassini

☒ Earth-based

☐ Galileo

☒ Hubble Telescope

☐ New Horizons

☒ Pioneer

☐ Voyager

## Instrument...

☐ Cassini CIRS

☐ Cassini ISS

☐ Cassini VIMS

☐ Galileo SSI

☐ NH LORRI

☐ Voyager ISS

## General > Basic Parameters

[Open All](#) || [Close All](#) || [Clear Page](#) || [Start Over](#)

☐ ▼ Planet

☐ Jupiter ☐ Saturn ☐ Uranus ☐ Neptune

☐ ► Target type

Define term

☐ ► Target name

Reset

☐ ► Mission

Suspend

☐ ► Instrument type

Restore

☐ ► Instrument name

Show valid range

☐ ► Measurement quantity

Quick picks

Add range

☐ ► Spatial sampling type

☐ ► Observation time

☐ ► Observation duration

☐ ► Observation ID

☐ [Show Advanced Options...](#)

## Result Summary

Observation count: Pending

[Show me my results](#)

Break down results by...

Select...

PDS

Atmospheres

Geosciences

Imaging

Navigation

Plasma/Particle Interactions

Rings

Small Bodies



# Web Site “Facelift”

- Goals: Ease of use, ease of maintenance, consistency, user appeal, compatibility with other nodes
- Standardized page templates and a Content Management System

# Node Internal Matters

- We're adopting Python/Django in a big way.
- Compared to equivalent C or FORTRAN, many codes are  $\sim 10$  x shorter.
- There's a library for everything!
- In-house development includes a CSPICE interface and a PDS3 label parser.
- It's FREE.
  - cf. IDL license fees.

# Coming Soon...

SETI Institute will be relocating  
this summer.